

MARK BRADLEY RESEARCH & CONSULTING

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Mr. Roelef van Ark
Chief Executive Officer
California High Speed Rail Authority
925 L Street, Suite 1425
Sacramento, CA 95814

Cc: Mr. Dan Leavitt; Ms. Carrie Pourvahidi

Dear Mr. van Ark

As principal of Mark Bradley Research and Consulting, I was a subconsultant to Cambridge Systematics for the passenger forecasting study carried out for the Metropolitan Transportation Commission (MTC) and California High Speed Rail Authority (CHSRA) from 2005 to 2007. My main roles on the project were the overall design of the structure of the inter-regional forecasting model system; the design of the Stated Preference mode choice survey experiments; a lead role in the estimation of all inter-regional choice models; and the design and programming of the software to apply the inter-regional models.

I have been a consultant in advanced travel demand modeling for 27 years. After working for Cambridge Systematics from 1983-1985, and then for the University of Oxford Transport Studies Unit, I became a founding member of the Hague Consulting Group (HCG), where I worked from 1986 to 1995. HCG, whose directors included Moshe Ben-Akiva, Andrew Daly and Hugh Gunn, was a pioneer in the use of advanced discrete choice models in forecasting. I had a lead role in estimating and programming the Dutch National Model, one of the world's first applied tour-based models. I carried out over 30 revealed preference (RP) and stated preference (SP) studies for various railways in Europe, including the Dutch, British, French, Swedish and Belgian railways. Particularly relevant to the CHSRA study, I participated with HCG in a number of high-speed rail forecasting projects, including projects for Eurotunnel, SNCF French railways and Union Railways. HCG, teamed with Cambridge Systematics, was contracted to prepare demand forecasts for the Australian Very Fast Train (VFT) project in the late 1980's, and I had a lead role in that project. Three different teams were contracted to produce initial demand forecasts independently from each other, and the HCG team was the only one retained to provide further forecasts in a second round of forecasting.

I established Mark Bradley Research and Consulting in Marin County, California in 1995, and relocated to Santa Barbara, California in 2002. In that time, I have had a primary role in designing and applying advanced discrete choice travel demand forecasting models for several regions of the U.S, including Portland, San Francisco, Sacramento, Atlanta, Seattle, St. Louis, Denver, and Minneapolis. I have also been at the forefront of the use of SP methods for forecasting the use of new alternatives, including studies of HOT lanes in Dallas, Los Angeles, Atlanta and Minneapolis; studies of new ferry alternatives in Seattle and San Francisco, and studies of new rail options in Minneapolis, Denver and Seattle. In the course of those projects, I have regularly teamed with the leading travel demand

forecasting consultancies in the country, including Cambridge Systematics, Parsons Brinckerhoff, DKS, CH2M Hill, HNTB, and Resource Systems Group.

I view the forecasting model system for CSHRA as one of the most technically advanced and successful projects I have had the opportunity to work on. As far as I am aware, no other long-distance passenger forecasting model in the world combines the advanced features of this model:

- Fully integrated hierarchical discrete choice models of several different choice levels, including trip frequency choice, destination choice, main mode choice, and access/egress mode choice;
- Simultaneous market segmentation by detailed geography, by a number of demographic characteristics including household size, income and auto ownership, as well as by trip purpose and travel party size.
- Fine level networks and spatial detail for over 6,000 zones, including fully detailed zones within urban areas;
- Integration with models of intra-regional travel at the same level of detail as used in the regional models for those regions (SCAG, MTC, SANDAG).
- Inter-regional model software that is fully integrated into network modeling software (CUBE), but also efficient enough to run a scenario within a few hours. (By comparison, travel demand models for a single region in the state often take more than 12 hours for a single run.)

During the course of the project, dozens of decision points arose regarding survey design, model system design, market segmentation, model specification, and model calibration and validation. I found that the level of communication and discussion regarding those decisions, between the project team members, the project clients, and the peer review panel, was as thorough as on any project I have been involved with. No key decisions were made unilaterally or without taking advantage of the considerable expertise and experience available to the team.

In my experience, the validity of a model for forecasting depends on a number of different factors:

- The conceptual design and level of integration of the model system as a whole;
- The specification (variables included and excluded) in each of the choice models;
- The quality of the input data—in this case mainly the SP survey data, the model validation data, and the extensive network data used to represent the spatial competition between the modes;
- The specific coefficients and parameters used in the model;
- The ability of the model to reproduce current (and past) choices among existing alternatives; and
- The sensitivity of the model to changes in the various input assumptions, and how those sensitivities compare to real-world evidence from similar contexts.

In my opinion, the last item—the sensitivity of the model to changes in the inputs—is the most informative one in judging the validity and applicability of a forecasting model, and one that the team relied upon heavily in the final stages of model calibration and validation. It results from the complex interaction of all of the aspects listed above it, and none of those aspects can be assessed very usefully without also investigating how they influence the predictive behavior of the model system as a whole. It is this vital aspect that I have found lacking in the review and critiques of the model system that I have seen to date. The critiques have mostly been speculative, with assumptions about how specific decisions made by the project team may have influenced the validity of the models. In my experience, model systems such as this are complex enough that it is impossible to say how a specific model parameter or assumption influences the resulting forecasts without empirically changing the assumption or parameter and then assessing the change in the forecasts.

I would be happy to provide any further details or answer any questions that might be raised by my comments,

Sincerely,

A handwritten signature in cursive script, reading "Mark A. Bradley".

Mark Bradley